High-k dielectrics on n-Al\textsubscript{0.25}Ga\textsubscript{0.75}N via atomic layer deposition N. NEPAL, N.Y. GARCES, D. MEYER, T.J. ANDERSON, J.K. HITE, M.A. MASTRO, C.R. EDDY, JR., U.S. Naval Research Laboratory, Washington, DC 20375, USA — AlGa\textsubscript{N}/GaN and AlInN/GaN high-electron-mobility transistors (HEMTs) are promising devices for high-temperature and high-power electronics applications. A key issue with these devices is the high gate leakage current, particularly for enhancement-mode HEMTs. There has been an increased interest in developing high quality gate insulators to reduce gate leakage current. Al\textsubscript{2}O\textsubscript{3} and HfO\textsubscript{2} layers (21nm thick) were deposited via atomic layer deposition on n-Al\textsubscript{0.25}Ga\textsubscript{0.75}N pretreated with one of two different surface preparations, H\textsubscript{2}O\textsubscript{2}:H\textsubscript{2}SO\textsubscript{4} (1:5) (piranha) or HF:H\textsubscript{2}O (1:3). Dielectrics were characterized using spectroscopic ellipsometry, X-ray photoelectron spectroscopy, atomic force microscopy (AFM), and capacitance-voltage (C-V) measurements. AFM shows that Al\textsubscript{2}O\textsubscript{3} and HfO\textsubscript{2} layers are continuous and uniform in thickness on both HF and piranha pretreated surfaces. However, C-V measurement shows smaller (15%) hysteresis for HF pretreated samples. The estimated dielectric constants ($\varepsilon$) are 9 and 18 for Al\textsubscript{2}O\textsubscript{3} and HfO\textsubscript{2} on HF pretreated surfaces, respectively, in general agreement with theoretical values of 9 and 25. Al\textsubscript{2}O\textsubscript{3} layers on Al\textsubscript{0.25}Ga\textsubscript{0.75}N exhibited a lower leakage ($7\times10^{-8}$ A/cm\textsuperscript{2} at 5 V) current and higher forward breakdown voltage of 7.5 MV/cm compared to that of HfO\textsubscript{2} layer. The higher breakdown voltage and lower leakage current for Al\textsubscript{2}O\textsubscript{3} is due to larger conduction band offset with Al\textsubscript{0.25}Ga\textsubscript{0.75}N.

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